inflated in this tent, care is taken to keep the opening turned away from the wind. The instruments are attached to the balloon, as is also a "ballast heaver," filled with sand or some liquid and provided with an aperture arranged in such a manner that it can empty itself in the proper interval, generally in about forty minutes. The balloon is then brought to the door of the tent; the ballast heaver is supported so as to facilitate the rising of the balloon a little, and the whole is then launched into the air with the least possible shake. Thanks to this device, we have been able to send up sounding balloons during storms in which the wind reached a velocity of 14 meters per second.

To avoid the disturbing influence of the rays of the sun and, above all, the radiation of the upper clouds when they are in great masses and form that sea of dazzling clouds so well known to alpine travelers and aeronauts, we have made the greater number of our night ascensions at first by moonlight—with a great deal of trouble, I must confess—and afterwards, when I succeeded in improving our apparatus, by electric light. Since the month of March, 1899, we have sent up more than a hundred and twenty balloons which have brought back curves of pressure and temperature. The height of 13,000 meters has been attained twenty-four times; 14,000 meters, eight times; 15,000 meters, three times.

We can with our present outfit reach a height of 13,000 meters nearly every time.

Confining the discussion of the observations collected to the atmosphere up to a height of 10,000 meters, the region explored by the greater number of the balloons, we see:

1. That the differences of temperature from one day to another may be greater at 7,000 or 8,000 meters than those observed the same day near the ground. This fact is of considerable importance and is besides contrary to the ideas we had previously formed on the subject.

2. We see that the temperature diminishes much faster near the centers of depression than elsewhere. This diminution reaches in certain cases about 0.90° C. per 100 meters.

Finally, it is remarked that in a great many areas of high pressure—I do not say in all—the decrease of temperature takes place in the following manner: from the ground to 1,500 or 2,000 meters the temperature varies little and sometimes even increases, after which it begins to diminish in a normal manner, and finishes by reaching at 9,000 or 10,000 meters a decrease of 1° per 100 meters. If we compare these values with those observed in the low areas we see that the variation in the vertical shows ordinarily the following characteristics:

The lower strata are often warmer in the areas of low pressure than in the areas of high pressure; but above several hundred meters of altitude the rapid diminution of temperature produces lower temperatures in the low areas.

Thus, the center of a depression at about 3,000 or 4,000 meters altitude is ordinarily colder than the corresponding part of the barometric maximum. This fact had already been demonstrated by Hann in his mountain observations; but the sounding balloons, while confirming this first result, show that higher up the temperatures have again a tendency to equalize themselves, and this is of great importance relative to the form of the upper isobars.

I would like to be able to say a few words about the temperature of the highest atmosphere, that which extends above the ordinary region of the cirrus clouds; but notwithstanding that we have observations at these altitudes, we shall have to wait to discuss them until we are certain that the thermometer—when the air is so greatly rarefied—is able, by simple contact, to come into thermal equilibrium with its surroundings. If it cannot, then we shall have to make use of special methods for determining the temperature at high altitudes.

MONTHLY STATEMENT OF AVERAGE WEATHER CONDITIONS FOR JANUARY.

By Prof. E. B. GARRIOTT.

The following statements are based on average weather conditions for January, as determined by long series of observations. As the weather of any given January does not conform strictly to the average conditions the statements can not be considered as forecasts:

January is a month of severe storms in the middle latitudes of the North Atlantic Ocean. Along the transatlantic steamship tracks these storms set in with southeast gales which shift to west and northwest with freezing temperature. Westward bound vessels experience sudden shifts of wind from the southeast and storms of comparatively short duration, and have prevailing strong head (westerly) winds. Storms encountered by eastward bound vessels are fewer in number and of longer duration; the vessels and the storms travel in the same direction. Storms seldom appear in the tropical regions of the Atlantic and Pacific oceans in January. On the north coast of western Cuba, however, and in the Gulf of Mexico, high and cold north winds are not uncommon during the winter months.

In the Lake region and the Atlantic coast districts of the United States the severest January storms come from the middle-West and Southwest, with northeast shifting to northwest gales; snow occurs on the north and rain or light snow on the south of the paths of the storms. In the Pacific coast States the rainy season is at its height, and strong gales occur from the central California coast to Alaska. In the Plateau and Rocky Mountain districts and on the great Plains the prevailing weather is fine and cold. This entire region is, however, subject to occasional cold waves of great severity, which, with snow and high winds, sweep southward to New Mexico and Texas and sometimes to the Rio Grande and northern Mexico, causing great losses of stock on the great ranges.

Frost is likely to occur in any part of the United States in January, and about once in five years severe freezes occur in the Gulf coast districts and in central and northern Florida.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

In communicating this abstract of the meteorological observations made in Costa Rica during January, 1901, and under date of February 20, Mr. Pittier says:

As far as the southwestern slope of this country is concerned, I do not think that agriculture is very much affected by any of our usual meteorological phenomena. As we have only one complete station, it would not be possible to construct charts of isobars, isotherms, and isohyets of Costa Rica. But I shall endeavor to establish a storm service so that we will be informed by telegraph of any storm occurring on the northeastern slope. Next week I go to Limon to establish a station there, the outfit of which will include a mercurial barometer, a registering aneroid, dry and wet bulb thermometers, Richard's dry and wet bulb registering thermometers, maximum and minimum thermometers, and the old rain gage. I have brought, also, a special outfit for the United Fruit Company, which I am going to put up at their farms at Zent. It includes one psychrometer, one maximum and one minimum thermometer, one pair maximum actinometers, one Jordan's sunshine recorder, and three earth thermometers. Mr. John Meiggs Keith, the General Manager of the Costa Rica division of the United Fruit Company, promises me to complete the outfit of instruments if we can obtain a good and permanent observer. As no white man can withstand indefinitely the mortiferous climate of Zent, I will try to get a young Jamaican negro, and bring him here for a few weeks, to be well instructed in the management of instruments, and then send him down.

TABLE I.—*Hourly observations at the Observatory, San Jose de Costa Rica, during January*, 1901.

Hours.	Pressure.		Temperature.		Relative humidity.		Rainfall.		
	Observed, 1901.	Normal, 1889-1900.	Observed, 1901.	Normal, 1889-1900.	Observed, 1901.	Normal, 1889-1900.	Observed, 1901.	Normal, 1889-1900.	During 1901.
	660+ mm.	660+ mm.	° C.	° C.	%	%	Mm.	Mm.	Hrs.
1 a.m	4.47	3.71	16.25	16.25	80	85	0.9	0.1	1.00
2 a.m	3.95	3.33	16.21	16.04	82	85	0.4	0.0	0.83
3 a.m	3.63	3.14	16.15	15.84	82	86	0.0	0.1	0.00
4 a.m	3.65	3.19	16.00	15.71	83	86	0.0	0.2	0.00
5 a.m	3.83	3.41	15.95	15.56	84	86	0.0	0.3	0.00
6 a.m	4.06	3.71	15.84	15.50	86	85	0.0	0.2	0.00
7 a.m	4.53	4.14	16.63	15.89	80	83	0.0	0.4	0.00
8 a.m	4.91	4.52	18.29	18.24	71	76	0.0	0.3	0.00
9 a.m	5.20	4.73	20.45	20.20	63	70	0.2	0.4	0.08
10 a.m	5.20	4.67	22.18	22.02	61	65	0.0	0.0	0.00
11 a.m	4.95	4.34	23.32	22.95	59	63	0.0	0.0	0.00
12 a.m	4.53	3.85	24.08	23.49	58	61	0.0	0.1	0.00
1 p.m	3.71	3.24	24.42	23.86	55	61	0.0	0.3	0.00
2 p.m	3.17	2.71	24.27	23.59	58	63	0.1	0.2	0.50
3 p.m	2.99	2.46	23.46	22.95	61	65	0.1	0.5	0.33
4 p.m	3.07	2.48	22.48	21.82	64	67	0.0	2.0	0.00
5 p.m	3.34	2.68	20.50	20.31	70	73	0.3	2.9	1.00
6 p.m	3.73	2.99	19.13	18.92	75	77	0.6	0.9	1.00
7 p.m	4.19	3.53	18.38	18.08	77	81	0.3	0.1	1.00
8 p.m	4.79	3.95	18.01	17.73	77	82	0.4	1.2	1.00
9 p.m	5.21	4.26	17.61	17.87	77	83	0.3	0.1	1.00
10 p.m	5.39	4.45	17.31	16.98	77	84	0.0	0.6	1.00
11 p.m	5.26	4.30	16.95	16.71	78	85	0.1	0.4	1.00
12 p.m	5.01	4.08	16.58	16.45	80	85	0.2	0.1	1.00
Mean	664.29	663.66	19.19	18.88	73	77	......	......	......
Minimum	661.3	660.04	10.7	9.8	......	......	......	......	......
Maximum	667.0	668.12	31.2	30.3	......	......	0.9	2.9	.. ..
Total	......	......	......	......	......	......	3.9	11.8	10.74

REMARKS.—The barometer is 1,169 meters above sea level. Readings are corrected for gravity, temperature, and instrumental error. The dry and wet bulb thermometers are 1.5 meters above ground and corrected for instrumental errors. The hourly readings for pressure, wet and dry bulb thermometers are obtained by means of Richard registering instruments, checked by direct observations every three hours from 7 a. m. to 10 p. m. The hourly rainfall is as given by Hottinger's self-register, checked once a day.

TABLE 2.

Time.	Sunshine.		Cloudiness	Temperature of the soil at depth of—				
	Observed, 1901.	Normal, 1889-1900.	Observed, 1901.	0.15 m.	0.30 m.	0.60 m.	1.20 m.	3.00 m.
	Hours.	Hours.	Per cent.	° C.	° C.	° C.	° C.	° C.
7 a.m.	4.46	8.28	31	19.45	19.83	20.05	20.26	20.87
8 a.m.	22.58	22.48						
9 a.m.	22.48	22.55						
10 a.m.	19.51	20.73	42	19.71	19.87	20.07	20.28	....
11 a.m.	18.59	19.74						
12 m.	17.47	18.42						
1 p.m.	18.00	17.99	45	20.38	20.05	20.07	20.31	....
2 p.m.	19.32	19.74						
3 p.m.	17.91	19.23						
4 p.m.	19.05	17.44	54	20.00	19 57	20.12	20.32	....
5 p.m.	15.48	12.70						
6 p.m.	2.70	2.54						
7 p.m.	....	....	34	20.48	20.22	20.03	20.26	....
8 p.m.	....	....						
9 p.m.	....	....						
10 p.m.	....	....	29	19.97	19.93	19.97	20.20	....
11 p.m.	....	....						
12 p.m.	....	....						
Mean	....	....	40	20.00	19.61	20.05	20.27	20.87
Total	197.55	201.79	....	....	....	....	....	....

Notes on the weather.—January 18–19, stormy days with strong east wind, high barometer and rain in San Jose; violent rainfall on the Atlantic slope with inundations and damage to the railroad.

Notes on earthquakes.—January 1, 6:57 and 7 p. m., two slight undulatory tremors from northwest to southeast; intensity, 4; duration, 5 seconds. January 7, 4:41 a. m., one slight undulatory movement, east-northeast to west-southwest, intensity 2, duration 3 seconds—6:27 p. m.; slight tremor north-northwest, intensity 4, duration 8 seconds—11 p. m., very slight trepidatory movement, intensity 1, duration 2 seconds.

TABLE 3.—*Rainfall at stations in Costa Rica during Janury*, 1901.

Stations.	Amount.	Days.	Stations.	Amount.	Days.
	Mm.			Mm.	
1. Boca Banano	265	17	13. Juan Vinas	159	14
2. Limon	304	19	14. Santiago‡	....	....
3. Swamp Mouth*	....	....	15. Paraiso‡	....	....
4. Zent‡	....	....	16. San Rafael C†	....	....
5. Gute Hoffnung	411	15	17. Tres Rios	2	1
6. Siquirres	406	10	18. La Palma†	....	....
7. Guapiles†	....	....	19. San Francisco G.	7	2
8. Sarapiqui†	....	....	20. San Jose	4	2
9. San Carlos	301	19	21. La Verbena†	....	....
10. Las Lomas	521	16	22. Alajuela†	....	....
11. Peralta†	....	....	23. Nuestro Amo†	....	....
12. Turrialba‡	....	....			

*Observations not complete. †Observations not received. ‡Observations to begin March 1.

RELATION OF THE WATER LEVEL OF GREAT SALT LAKE TO THE PRECIPITATION.

By L. H. MURDOCH, Section Director, dated January 25, 1901.

On December 31, 1900, the water level of Great Salt Lake was 9 inches below the zero of the scale, measured on the gage at Garfield Beach. This gage was established many years ago by the United States Geological Survey and its zero placed at what was believed to be one foot below the lowest known water. Many old settlers claim, however, that the water was lower in 1848 than the point accepted by the officials of the United States Geological Survey as the lowest known level. In 1848 there was a dry bar extending from the mainland to Antelope Island. In September of 1900 this bar was again exposed, and since then it has been possible to drive or walk to the island dry shod. There can be but little doubt that the reading of minus 9 inches is the lowest water level reached since the settlement of the State.

The question naturally arises, what is the cause of this remarkable fall in the lake and will it continue to fall and finally disappear within a few years?

One explanation offered is that the fall is due to the diverting of large quantities of water from the streams flowing into the lake for irrigation purposes. With a view to ascertaining how far a shortage in precipitation is responsible for this decline in the lake level, all the precipitation data collected in the Great Salt Lake basin was tabulated and the averages calculated and compared. But it was seen that objection could be raised to any conclusions drawn from these averages for the reason that the average annual rainfall of the basin ranges from less than 5 inches in the driest parts to about 18 inches where the precipitation is heaviest, and as stations have been established here and discontinued there, it was seen that the data was not comparable. Nevertheless, the results of these calculations and comparisons show that the last fifteen years have been the driest on record.

The precipitation data for Salt Lake City, including that for Fort Douglas, are complete back to 1863, with the exception of the data for 1866. The data for Ogden and Corinne are complete back to and including 1871. These stations lie a few miles east of the lake, and the distance from Corinne on the north to Salt Lake City on the south is about 55 miles. The data for these stations were tabulated, averages obtained for each year, and the results charted.

The average annual precipitation for these three stations from 1863 to 1900, inclusive, is 14.65 inches. The last decline in the water level of the lake began in 1887. The average precipitation from 1863 to 1885, inclusive, is 15.32 inches, while the average from 1886 to 1900, inclusive (fifteen years), is only 13.67 inches, which is 0.98 inches below the average for all years and 1.65 inches below the average for the pre-